DETAILED ACTION

Response to Arguments

1. Applicant's arguments, filed 3/11/2008, with respect to the rejection(s) of claim(s) 1-23 under 35 USC 103(a) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of US 6,389,062, US 2003/0147655, US 6,563,841 and US 2001/0031016.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1, 2, 6, 7 and 9 are rejected under 35 U.S.C. 102(e) as being anticipated by Wu (US 6,389,062).

- With regard claim 1, Wu discloses a communications receiver that comprises:

an analog-to-digital converter that samples a DMT (discrete multi-tone) signal to obtain a digital receive signal (Fig.10 element 76);

a transform module coupled to the analog-to-digital converter and configured to determine amplitudes associated with frequency components of the

digital receive signal (Fig.10 element 60, FFT, where the FFT accepts received time domain signals from input, and converts them to frequency domain representations of the symbols. Each frequency bin (or output) of the FFT corresponds to the magnitude and phase of the carrier at the corresponding frequency.); and

a detection module configured to determine a channel symbol from the frequency component amplitudes while accounting for correlation between the frequency component amplitudes of the digital receive signal (Fig.10 elements 62, 64 and feedback signal e(n), and column 11 line 48 – column 12 line 48, where the correlation between the frequency component amplitudes of the digital receive signal is provided by the error feedback signal e(n)).

- With regard claim 2, Wu further discloses determination of the most probable channel symbol given the amplitudes determined by the transform module (Fig.10 element 62 outputs, where FEQ corrects the possible error provided by the slicer 64 to generate the most probable channel symbols).
- With regard claim 6, Wu further discloses a time domain equalizer (Fig.10 element 78) that operates on the digital receive signal to maximize a percentage of impulse response energy in a predetermined interval.
- With regard claim 7, Wu further discloses a cyclic prefix remover (Fig.10 element 80) that removes prefixes from the digital receive signal, each prefix being associated with a respective channel symbol.

- With regard claim 9, Wu further discloses wherein the transform module performs a fast Fourier Transform (FFT) on the receive signal in each channel symbol interval (Fig.10 element 60).

4. Claims 10-12 and 17-20 are rejected under 35 U.S.C. 102(e) as being anticipated by Shattil (US 2003/0147655).

- With regard claim 10, Shattil discloses a communications receiver that comprises:

  an analog-to-digital converter that samples a DMT (discrete multi-tone) signal to obtain a digital receive signal (Fig.13B element 1301);

  a transform module coupled to the analog-to-digital converter and configured to determine amplitudes associated with frequency components of the digital receive signal (Fig.13B element 1302 and Fig.13D element 1302 and paragraph [0187]); and

  a detection module configured to determine a channel symbol from the amplitudes while accounting for correlation between the amplitudes (Fig.13B element 1302 and Fig.13C element 1302 and paragraph [0187]),

  wherein the transform module includes a bank of matched bandpass filters (Fig.13B element 1302 and Fig.13C element 1302 and paragraph [0187]).

- With regard claim 11, Shattil discloses a method of receiving OFDM (orthogonal frequency division multiplexing) modulated data, wherein the method comprises:

determining a set of frequency component amplitudes associated with a channel symbol interval of a receive signal (Fig.13B element 1302 and Fig.13D element 1302 and paragraph [0187], where FFT is used to determine the set of frequency component amplitudes associated with a channel symbol interval of a receive signal); and

determining a channel symbol associated with the set of frequency component amplitudes while accounting for correlation between the frequency component amplitudes associated with the channel symbol interval of the receive signal (Fig.13B element 1302 and Fig.13C element 1302 and paragraph [0187], where the matched filter bank is used to determine the channel symbol associated with the set of frequency component amplitudes while accounting for correlation between the frequency component amplitudes associated with the channel symbol interval of the receive signal).

- With regard claim 12, Shattil further discloses wherein said determining a channel symbol includes: identifying a channel symbol that is most probably correct given the set of frequency component amplitudes (Fig.13B element 1302 and Fig.13C element 1302 and paragraph [0187], where the output of the matched filter bank is the identified channel symbol that is most probably correct given the set of frequency component amplitudes since the matched filter output is always have maximized signal to noise ratio that is most probably corrected channel symbol).

- With regard claim 17, Shattil further discloses removing a prefix from each symbol interval of the receive signal before performing said determining a set of frequency component amplitudes (Fig.13B element 1301).
- With regard claim 18, Shattil further discloses converting the receive signal into digital form (Fig.13B element 1301); and performing a fast Fourier Transform on the digital receive signal (Fig.13D element 1302).
- With regard claim 19, Shattil discloses a communication system comprising:

a transmitter that transmits an OFDM modulated signal (paragraph 179); and

a receiver that receives and demodulates a corrupted version of the OFDM modulated signal, wherein the receiver includes (paragraph 179, where it is well known in the art that the received signal transmitted from a transmitter is additive to noise):

an analog-to-digital converter that samples a DMT (discrete multi-tone) signal to obtain a digital receive signal (Fig.13B element 1301);

a transform module coupled to the analog-to-digital converter and configured to determine amplitudes associated with frequency components of the digital receive signal (Fig.13B element 1302 and Fig.13D element 1302 and paragraph [0187]); and

a detection module configured to determine a channel symbol from the amplitudes while accounting for correlation between the amplitudes (Fig.13B element 1302 and Fig.13C element 1302 and paragraph [0187]).

- With regard claim 20, Shattil further discloses determination of the most probable channel symbol given the amplitudes determined by the transform module ((Fig.13B element 1302 and Fig.13C element 1302 and paragraph [0187], where the output of the matched filter bank is the identified channel symbol that is most probably correct given the set of frequency component amplitudes since the matched filter output is always have maximized signal to noise ratio that is most probably corrected channel symbol).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 3 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu (US 6,389,062) in view of Nedic et al. (US 6,563,841).

- With regard claim 3, Wu discloses all of the subject matter as described in the above paragraph except for specifically teaching weighted sum unit associated with each frequency component, wherein each weighted sum unit combines a

plurality of amplitudes from the transform module in a manner designed to minimize any error between the output of the weighted sum unit and a valid output value.

However, Nedic et al. teaches that weighted sum unit (Fig.7 element 120) associated with each frequency component (Fig.7 element Yk via 114, feedforward filter), wherein each weighted sum unit combines a plurality of amplitudes from the transform module (Fig.3 element 106, FFT, and Fig.7 element Yk via 114, feedforward filter) in a manner designed to minimize any error between the output of the weighted sum unit and a valid output value (column 11 lines 10-21) in order to reduce the error to minimum so that the inter-symbol-interference can be improved. Therefore, It would have been obvious to one of ordinary skill in the art at the time of the invention was made to implement the frequency domain equalizer circuit as taught by Nedic et al. into Wu's receiver to replace the FEQ 62 so as to improve the inter-symbol-interference.

- With regard claim 5, the modified circuit of Wu and Nedic et al. further teaches a subtraction module (Fig.7 element 120, Nedic's reference) that removes trailing intersymbol interference from the output of the transform module (where the subtractor 120 subtracts the feedback signal 126 from FFT output via Yk and feedforward filter 114) to obtain ISI-corrected frequency component values (where it is well known that the decision feedback equalizer as shown in Fig.7 is used to eliminate the ISI, column 13 lines 24-35); a decision unit (column 10 lines 20-36) that determines a matrix product of a matrix M and a vector of ISI-

corrected frequency component values to obtain the channel symbol (Fig.7 element 116 and column 10 lines 20-36); and a feedback module that determines a matrix product of a matrix T and the channel symbol (Fig.7 element 126) from the decision unit to provide the trailing intersymbol interference to the subtraction module (where it is well known that the decision feedback equalizer as shown in Fig.7 is used to eliminate the ISI, column 13 lines 24-35).

7. Claims 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wu (US 6,389,062) in view of Seagraves (US 2001/0031016).

- With regard claim 8, Wu discloses all of the subject matter as described in the above paragraph except for specifically teaching an error correction code decoder that decodes channel symbols received from the detection module.

  However, Seagraves teaches an error correction code decoder that decodes channel symbols received from the detection module (paragraph 38) in order to ensure a robust and efficient transmission. Therefore, It would have been obvious to one of ordinary skill in the art at the time of the invention was made to include the FEC decoder as taught by Seagraves into Wu's receiver circuit so as to ensure a robust and efficient transmission.

8. Claims 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shattil (US 2003/0147655).

- With regard claim 13, Shattil discloses all of the subject matter as described in the above paragraph except for specifically teaching for each frequency

component: calculating a weighted sum of frequency component amplitudes that minimizes expected error energy of the frequency component.

However, in another embodiment Shattil teaches that for each frequency component: calculating a weighted sum of frequency component amplitudes that minimizes expected error energy of the frequency component (paragraph 214) in order to provide better performance known as MMSE detection. Therefore, It would have been obvious to one of ordinary skill in the art at the time of the invention was made to include the MMSE detection method as taught by Shattil in order to provide better performance.

9. Claims 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shattil (US 2003/0147655) in view of Wu (US 6,389,062).

- With regard claim 16, Seagraves discloses all of the subject matter as described in the above paragraph except for specifically teaching processing the receive signal to shorten the effective channel impulse response before performing said determining a set of frequency component amplitudes (Fig.4 element 31 and column 9 lines 55-67) in order to reduce the length of the tap so that the expense of the long tap FIR filter can be reduced. Therefore, It would have been obvious to one of ordinary skill in the art at the time of the invention was made to include the TEQ as taught by Wu into Shattil’s receiver before the FFT unit in order to reduce the cost.

10. Claims 21 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shattil (US 2003/0147655) in view of Nedic et al. (US 6,563,841).

- With regard claim 21, Shattil discloses all of the subject matter as described in the above paragraph except for specifically teaching weighted sum unit associated with each frequency component, wherein each weighted sum unit combines a plurality of amplitudes from the transform module in a manner designed to minimize any error between the output of the weighted sum unit and a valid output value.

  However, Nedic et al. teaches that weighted sum unit (Fig.7 element 120) associated with each frequency component (Fig.7 element Yk via 114, feedforward filter), wherein each weighted sum unit combines a plurality of amplitudes from the transform module (Fig.3 element 106, FFT, and Fig.7 element Yk via 114, feedforward filter) in a manner designed to minimize any error between the output of the weighted sum unit and a valid output value (column 11 lines 10-21) in order to reduce the error to minimum so that the inter-symbol-interference can be improved. Therefore, It would have been obvious to one of ordinary skill in the art at the time of the invention was made to implement the frequency domain equalizer circuit as taught by Nedic et al. into Shattil's receiver to replace the FEQ 1303 (Fig.13B) so as to improve the inter-symbol-interference.

- With regard claim 23, the modified circuit of Shattil and Nedic et al. further teaches a subtraction module (Fig.7 element 120, Nedic's reference) that removes trailing intersymbol interference from the output of the transform module (where the subtractor 120 subtracts the feedback signal 126 from FFT output via

Yk and feedforward filter 114) to obtain ISI-corrected frequency component values (where it is well known that the decision feedback equalizer as shown in Fig.7 is used to eliminate the ISI, column 13 lines 24-35); a decision unit (column 10 lines 20-36) that determines a matrix product of a matrix M and a vector of ISI-corrected frequency component values to obtain the channel symbol (Fig.7 element 116 and column 10 lines 20-36); and a feedback module that determines a matrix product of a matrix T and the channel symbol (Fig.7 element 126) from the decision unit to provide the trailing intersymbol interference to the subtraction module (where it is well known that the decision feedback equalizer as shown in Fig.7 is used to eliminate the ISI, column 13 lines 24-35).

Allowable Subject Matter

11. Claim 14 is allowed.

12. Claims 4, 15 and 22 are objected to as being dependent upon an objected claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ted M. Wang whose telephone number is 571-272-3053. The examiner can normally be reached on M-F, 7:30 AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chieh Fan can be reached on 571-272-3042. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Ted M Wang/
Primary Examiner, Art Unit 2611